



Intel® PRO/Wireless Network Connection Products

Antenna Vendor List

Revision 4.0

January 10, 2005



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Document Revision History

Document Revision Number	Date	Comments
4.0	January 10, 2005	Added new vendor information
3.0	August 30, 2004	Added new vendor information
2.01	October 29, 2003	Edited for customer release
2.0	July, 2003	Revised vendor data to reflect compliance with Intel® PRO/Wireless 2200BG Network Connection antenna specification Added two vendors
1.0	2003	Initial release

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1 Introduction

The Wireless Products Division (WPD) of Intel Corporation has prepared this antenna vendor document and attached vendor reference documents to assist customers in identifying and procuring quality standard antenna components to be used with Intel® PRO/Wireless Network Connection Wireless Local Area Network (WLAN) products.

Antenna components required for operation of Intel PRO/Wireless Network Connection WLAN MiniPCI and Peripheral Component Interconnect (PCI) cards may include connectors, cables, and radiating elements.

The antenna components listed in this document have been verified by Intel to function properly with its PRO/Wireless Network Connection WLAN products. Only antenna components listed here have been verified by Intel.

Intel customers are encouraged to use the components listed in this document but are not restricted in any way from using other components from the same or other vendors. However, customers should be aware and are cautioned that use of components not verified by Intel could have a negative impact on system performance.

Consult your Intel field sales representative to understand possible performance impacts due to use of non-recommended components.

Note: Attached vendor documents are provided for reference only. Contact the vendors directly using the information at the end of this document for the latest detailed product information.

Note: In the event that preferred pricing is available from the suppliers listed in this document, the Intel part numbers cited in this document must be used when ordering.

2 List of Recommended Components

This section provides information about components recommended by Intel.

2.1 Connectors

The following connectors are recommended:

Hirose* U.FL Series MiniPCI Connectors

2.2 Cables

The following cables are recommended:

- Coax cables for MiniPCI
 - Hirose
 - Hitachi-Cable* Low Loss
- Coax cables for PCI

2.3 Radiating Elements

The following elements are recommended:

- Hitachi-Cable Wide Band Film antenna
- Ethertronics* GS Series
- SkyCross* Quad-Band Worldwide 802.11a/b/g
- Kosan* KBWI-COIU-16R
- Antenova WLAN antenna products
- Tyco Antenna Products 802.11a/b/g antenna
- Centurion Wireless Technologies 802.11 a/b/g antenna

3 Connectors

Connectors have an important role in radio frequency (RF) transmit and receiver chains. It is critical that the RF connectors used provide reliable electrical connections and introduce very low loss. It is also important to note that mechanically compatible connectors may not necessarily provide the same electrical performance. For this reason, it is important to use the recommended components listed in Table 1. If components other than those listed are used, electrical and mechanical properties must be verified for compliance with Intel standards.

3.1 Hirose U.FL Series MiniPCI Connectors (Internal Applications)

Intel PRO/Wireless Network Connection MiniPCI WLAN products use the Hirose U.FL connector series (see attached data sheet) to connect off-board antenna systems to the MiniPCI card installed in laptop and mobile devices. The receptacle U.FL-R-SMT(10)-IN comes mounted on Intel PRO/Wireless Network Connection WLAN MiniPCI boards. In addition, a variety of SMA to U.FL adapters is available for testing both the antenna assembly and the MiniPCI card.

Table 1: Hirose U.FL Series MiniPCI Connectors

Hirose Part Number	Description	Lead Time
U.FL-R-SMT(10)-IN	SMT Receptacle	2 weeks ¹
U.FL-2LP-088-A-IN-(L) ²	Double-ended cable assembly	4 weeks ¹
U.FL-LP-088-A-IN-(L) ²	Single-ended cable assembly	4 weeks ¹
HRMP-U.FLJ-IN	SMA plug / U.FL. jack adapter	2 weeks
HRMJ-U.FLP-IN	SMA jack / U.FL plug adapter	2 weeks
U.FL-R-1-IN	Receptacle for inspection	3 weeks
U.FL-LP-N-02(01)-IN	Plug extraction tool	2 weeks

Notes:

¹Forecast required.

²L represents length in millimeters (cable assembly cost changes depending on cable length).

Cable assemblies may also be obtained from Hirose, including the U.FL plugs installed on both ends of the cable (single-ended cable assemblies are also available). The part numbers shown in Table 1 are examples of products that can be used with the Hirose 088 cable (see Section 4 for information about cable selection). Contact the manufacturer for assistance in ordering connectors, cable assemblies, and adapters. Remember to use Intel part numbers to take advantage of price incentives.

4 Cables

The coaxial cable used to connect the antenna to the radio may introduce a significant loss of power. This is especially true when the antenna is located far from the radio. As a result, it is important to consider both the electrical and mechanical properties of the coax. The mechanical dimensions of the cable (namely the outer diameter [OD]) should not be the only factor driving cable selection. Depending on the application (MiniPCI or PCI), a small difference in mechanical size can result in a big difference in electrical performance.

4.1 Coaxial Cables for MiniPCI

The trade-off between cable OD dimensions and electrical performance is illustrated in laptop and mobile devices where space for cable routing is at a premium. If considered early enough in the design cycle, larger OD cables with better electrical performance may have space allowances created for them. This results in increased performance of 3 dB in output power and greater product range and throughput (see Table 2). Intel supplied the cable loss measurements, and Hirose and Hitachi-Cable provided the cables.

4.1.1 Hirose Cables

The following table provides Hirose cable data.

Table 2: Hirose Cables

Cable Part Number	Outer Diameter [mm]	Transmission Loss [dB/m] @ 2.5 GHz	Transmission Loss [dB/m] @ 5.8 GHz
04	0.81	-5.3	-8.8
066	1.32	-3.2	-6.1
068	1.13	-3.4	-5.8
088	1.37	-2.9	-4.7

4.1.2 Hitachi-Cable Low-Loss Cables

The following table provides Hitachi-Cable low-loss cable data.

Table 3: Hitachi-Cable Low-Loss Cables

Cable Part Number	Outer Diameter [mm]	Transmission Loss [dB/m] @ 2.5 GHz	Transmission Loss [dB/m] @ 5.8 GHz
UL1745-SB CX-50 1x32AWG(7/0.08)	1.13	-3.1	-5.0

Note: Contact information for Hirose and Hitachi-Cable is provided at the end of this document. Please contact the manufacturers or your Intel field sales engineer for further product information.

4.2 Coaxial Cables for PCI

Cables used to connect external and internal antennas for PCI WLAN products may use a larger OD cable. The larger OD cable has less loss than cable used for the MiniPCI. If the cable is selected carefully, a 6-foot length of cable that connects the external PCI antenna will have loss parameters equivalent to 18 inches of coax used to connect the MiniPCI antenna. An example of a larger OD coax cable is shown in Table 4.

Table 4: Example: Larger OD Coax Cable

Cable Part Number	Outer Diameter [mm]	Transmission Loss [dB/m] @ 2.5 GHz	Transmission Loss [dB/m] @ 5.8 GHz
Hirose 098110	3	-1.17	-1.83

Contact information for Hirose and Hitachi-Cable is provided at the end of this document. Please contact the manufacturers or your Intel field sales engineer for further product information.

5 Radiating Elements

Intel evaluated many radiating elements and selected antenna vendors. Intel selected these elements based on their physical dimensions (small form factor) and electrical performance (return loss, gain). Intel used these antennas for performance verification and regulatory compliance testing. The rest of this section describes each element and provides reference to useful data sheets and installation instructions.

5.1 Hitachi-Cable Wide Band Film Antenna

The Hitachi-Cable film antenna is a thin radiating element with good electrical performance over both 802.11b and 802.11a (including Japanese channels) frequency bands. A photograph of the antenna element is shown in Figure 1. Its thin physical dimension allows it to be easily integrated into laptop or mobile platforms.



Figure 1: Photograph of Antenna Element

Note: Figure 1 shows an older version. For the latest components, please contact Hitachi-Cable (dimensions: 30 mm x 30 mm x 0.2 mm)

When using this type of antenna element it is important to follow the manufacturer's instructions for mounting and placement. See the manufacturer's Installation Guidance, Part Number ES032-1028. Failure to follow manufacturer's instructions may result in substantially reduced performance. It is highly recommended that you work with the antenna manufacturer while integrating the antenna into the platform.

In addition, the manufacturer provides several different radiating elements to support a variety of mounting configurations, including free space, for evaluation and regulatory certification purposes.

In Table 5, the Hitachi-Cable antenna part# details have been provided.

Table 5: Radiating Elements

Part Number	Application
TLB-A	Wide band (2.4/4.8-6.2 GHz)
TLB-B	Wide band (2.4/4.8-6.2 GHz)
TLB-C	Wide band (2.4/4.8-6.2 GHz)

Hitachi-Cable contact information for design support and sales is provided at the end of this document.

5.2 Ethertronics GS Series

Ethertronics GS series (see attached data sheet) offers the MPCIO8001 for 802.11 a/b/g systems. This antenna may be integrated into a new or existing enclosure with minimal design effort. The construction of the radiating elements allows a unit to be placed on the enclosures edge for maximum transmit (TX) and receive (RX) signal strength (see attached application note). Further, this design creates a high degree of isolation between the elements and other internal interferences for improved diversity performance.



Figure 2: MiniPCI Assembly, Part Number MCPI 08001

Note: In Figure 2, the radiating element was mounted on a ground plane for testing.

Ethertronics provides several GS series radiating elements to support a variety of mounting configurations for free space and regulatory certification purposes.

In Table 6, the GS Series part# details have been provided.

Table 6: GS Series and Elements

Product	Applications	Frequency
MPCIO8001	MiniPCI card accessory, notebook computer, desktop computer, tablet PC, access point, repeater, monitor	2.4/4.9/5.2/5.8 GHz

For best results when testing inside an enclosure or to ensure optimum placement of the antenna, Intel recommends that Ethertronics be contacted directly. Samples of GS components and installation support are available worldwide.

Ethertronics contact information for design support and sales is provided at the end of this document.

5.3 SkyCross Quad-Band Worldwide 802.11a/b/g

SkyCross has developed a quad-band antenna for integration into laptop computers (see attached data sheet). The radiating element is small enough to be integrated into the laptop lid and provides worldwide radio support. In addition, SkyCross provides a website detailing all development activities for the Intel PRO/Wireless Network Connection product family and an online antenna integration and design guide.

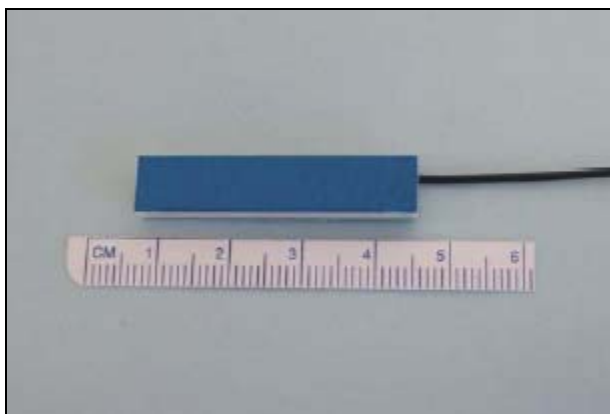


Figure 3: SkyCross Quad Band WLAN Antenna

In Table 7, the SkyCross antenna part# details have been provided.

Table 7: SkyCross Quad Band WLAN Antenna

Product	Applications	Frequency
CBL-EMWQU-A	MiniPCI card accessory, notebook computer, desktop computer, tablet PC, access point, repeater, monitor	2.4/4.9/5.2/5.8 GHz

For best results when testing inside an enclosure or to ensure optimum placement of the antenna, Intel recommends that SkyCross be consulted directly. Samples of the quad band components and installation support are available worldwide.

SkyCross contact information for design support and sales is provided at the end of this document.

5.4 Kosan

Kosan provides a small multi-band antenna (see attached data sheet) compatible with Intel's antenna specification and capable of supporting 802.11a/b/g bands of operation (including Japanese channels). The antenna is small enough to be suitable for mounting in the laptop LCD panel.



Figure 4: Kosan KBWI-COIU-16R Cable Antenna Elements

Performance of this antenna mounted in the LCD panel is described in the attached datasheet.

In Table 8, the Kosan antenna part# details have been provided.

Table 8: Kosan KBWI-COIU-16R Cable Antenna Elements

Product	Applications	Frequency
KBWI-COIU-16R	MiniPCI card accessory, notebook computer, desktop computer, tablet PC, access point, repeater, monitor	2.4/4.9/5.2/5.8 GHz

For best results when testing inside an enclosure or to ensure optimum placement of the antenna, Intel recommends that Kosan be consulted directly. Samples of the cable antenna components and installation support are available worldwide.

Kosan contact information for design support and sales is provided at the end of this document.

5.5 Antenova

Antenova provides a small multi-band antenna (see attached datasheet) compatible with Intel's antenna specification and capable of supporting 802.11a/b/g bands of operation. It is an effective solution without compromise in RF performance. The antenna is capable of being positioned in both a vertical and horizontal configuration, allowing the option of both polarization and space diversity, thus giving better diversity isolation.

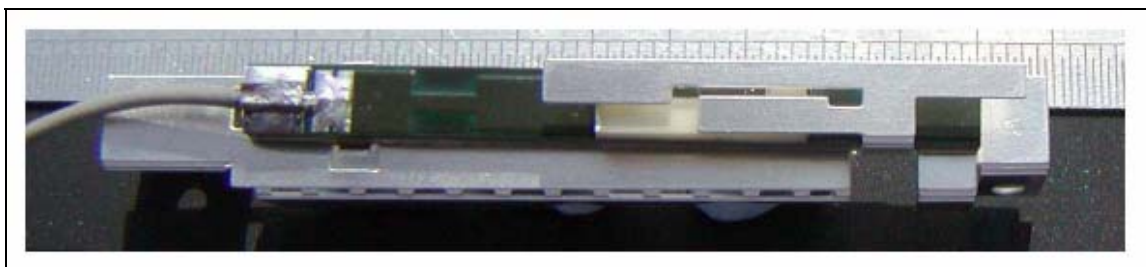


Figure 5: Antenova WLAN Internal Antenna

Performance for two antennas fully integrated around the LCD of a notebook in a vertical and horizontal configuration is described in the attached datasheet.

In Table 9, the Antenova antenna part# details have been provided.

Table 9: Antenova WLAN Internal Antenna

Product	Applications	Frequency
P/No: A10042-1 Revision: A	MiniPCI card accessory, notebook computer, desktop computer, tablet PC, access point, repeater, monitor	2.4/4.9/5.2/5.8 GHz

The antenna element consists of a silver-plated steel radiator, electromagnetically coupled with a ceramic puck and reflowed onto a printed circuit board. This configuration gives the benefits of performance, stability, and resistance to detuning that metal, Printed Circuit Board (PCB), and ceramic solutions are able to provide.

Within the notebook, the structure is designed to sit around the LCD with attachment/grounding to the metal lid. Fixtures may be either screwed or applied with conductive adhesive. A window must be used for correct operation.

Antenova contact information for design support and sales is provided at the end of this document.

5.6 Tyco Antenna Products Worldwide 802.11a/b/g

Tyco Antenna Products now offers the *high performance 1513444-1* (see attached datasheet) for 802.11 a/b/g systems that is completely compatible with Intel's antenna specifications. The small form factor and mounting make it very easy to integrate into laptops and a wide variety of applications.



Figure 6: Tyco Antenna Products 802.11a/b/g Antenna

In Table 10, the Tyco antenna part# details have been provided.

Table 10: Tyco Antenna Products 802.11a/b/g Antenna

Product	Applications	Frequency
TYCO 1513444-1	MiniPCI card accessory, notebook computer, desktop computer, tablet	2.4/4.9/5.2/5.8 GHz

For best results when testing or to insure optimum placement of the antenna, it is strongly Recommended that Tyco Antenna Products Design Integration Team be consulted directly. Samples and support of this antenna are provided worldwide by Tyco electronics.

Tyco contact information for design support and sales is provided at the end of this document.

5.7 Centurion Wireless Technologies 802.11a/b/g

Centurion Wireless Technologies now offers the *high performance* CAF28961/CAF28962 (see attached datasheet) for 802.11 a/b/g systems that are completely compatible with Intel's antenna specifications. The antenna is designed to operate within a dielectric radiation window in the top of a laptop computer. The small form factor and mounting make it very easy to integrate into laptops and a wide variety of applications.



Figure 7: Tyco Antenna Products 802.11a/b/g Antenna

The Centurion antenna part# details are provided in Table 11.

Table 11: Centurion Antenna Products 802.11a/b/g Antenna

Product	Applications	Frequency
CAF28961 CAF28962	MiniPCI card accessory, notebook computer, desktop computer, tablet	2.4-2.5/4.9-5.875 GHz

The Centurion antenna electrical specifications are provided in Table 12 while the mechanical specifications are provided in Table 13 below.

Table 12: Electrical Specifications

Frequency	2.4 - 2.5 GHz	
	4.9 – 5.875 GHz	
Average Gain (Azimuth)	> -3 dBi	2.4-2.5 GHz
	> -5 dBi	4.9 – 5.875 GHz
VSWR	2:1	2.4-2.5 GHz
		4.9-5.875 GHz
Isolation	> 17 dB	2.4-2.5 GHz
	> 33 dB	4.9 – 5.875 GHz

Table 13: Mechanical Specifications

Dimensions	30 mm x 20 mm x .5 mm	
	(1.81 mm at cable)	
Cable Length	CAF28961	336 mm
	CAF28962	471 mm

The specification sheet provides an illustration of the approximate dimensions which should be maintained for the best potential antenna performance when mounted in a laptop. The distance from the top of the antenna to the top of the notebook should be greater than or equal to 3mm. The distance from the antenna to the edge of the radiating window should be 5mm or greater. The distance from the bottom of the antenna to the bottom of the radiating window is 9mm. The distance from either face of the antenna should be 2.5mm or greater.

For best results when testing or to insure optimum placement of the antenna, it is strongly recommended that Centurion Wireless Technologies be consulted directly. Samples and support of this antenna are provided by Centurion Wireless Technologies.

Centurion contact information for design support and sales is provided at the end of this document.

6 Supplier Contacts

This section provides information about supplier contacts mentioned in previous sections of this document.

Hirose:

Hirose Electric U.S.A., Inc.
2688 Westhills Court
Simi Valley, CA 93065-6235
Phone: 1-800-522-7958

Hirose Electric Co., LTD.
1-11, Osaki 5-chome
Tokyo 141-8586, Japan
Phone: 81-3-3491-9741

Hirose Electric Taiwan Co., Ltd
No. 28 Lane 247 Sec. 2
Yen Ping N. Rd.
Taipei
Phone: 886-2-2557-7351

Note: Other locations exist and may be found in the attached document.

Hitachi-Cable:

Hitachi-Cable America Inc.

3625 Del Amo Boulevard

Suite 385

Torrance, CA 90503

Contact: Aki Kenmotsu

Phone: (310) 542-9680

Hitachi-Cable Head Office

Otemachi-Building

6-1 Otemachi 1-chome, Chiyoda-ku

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Phone: +81-3-3216-1616

Hitachi Cable Asia, Taipei Branch

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International Trade Building

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Professional Computer Technology Limited
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Phone: 886-2-2698-0098
Fax: 886-2-2698-0966
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Web: www.pct.com.tw

Note: Other locations exist and can be found on the Ethertronics website.

SkyCross:

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Corporate Office

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Email: bbishop@tycoelectronics.com

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Mobile: +886-932216893

China Mobile: +86-13681847726

Email: ted.chen@tycoelectronics.com

Contact : Ted Chen

Tyco Antenna Products Web Site:

<http://www.rangestar.com/default.asp>

Centurion Wireless Technologies Corporation:

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3425 N. 44th Street

Lincoln, Nebraska 68504

Phone: 402-467-4491

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Email: michael.rigdon@centurion.com / sales@centurion.com

Contacts: Michael Rigdon

Centurion Wireless Technologies Web Site:

<http://www.centurion.com>